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ABSTRACT

This booklet was designed as a reference for teachers and students of physics on various types of data. Included are: (1) formulas for various constants involved in the study of gravity, electricity, magnetism, atomic physics, particles, and trigonometry; (2) a chart containing values of trigometric functions; (3) equations used in the study of kinematics, dynamics, momentum and energy, waves and light, electricity and magnetism, atomic physics, and relativity and quantum physics; and (4) a periodic chart of the elements. (TW)

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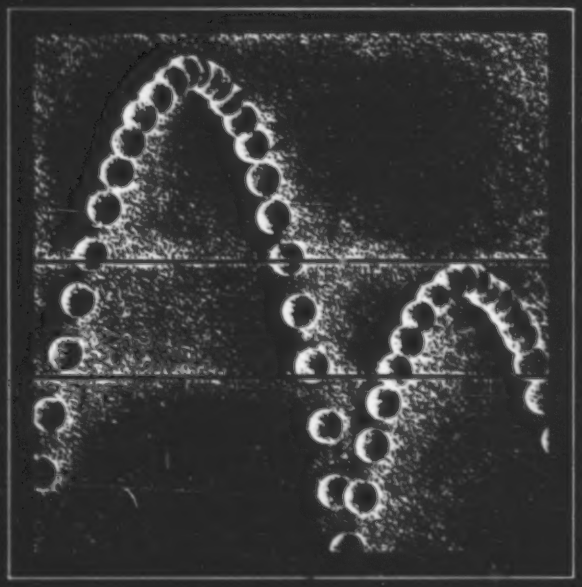

PHYSICS
DATA BOOKLET

(Revised 1987)

Alberta
EDUCATION

PHYSICS

CONSTANTS

GRAVITY, ELECTRICITY, AND MAGNETISM

Acceleration Due to Gravity or Gravitation Field Near Earth	g or $a_g = 9.81\ m/s^2$ or $9.81\ N/kg$
Gravitational Constant	$G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$
Mass of Earth	$M_e = 5.98 \times 10^{24}\ kg$
Radius of Earth	$R_e = 6.37 \times 10^{6}\ m$
Coulomb's Constant	$k = 8.99 \times 10^{9}\ N \cdot m^2/C^2$
Electron Volt	$1\ eV = 1.60 \times 10^{-19}\ J$
Elementary Charge	$e = 1.60 \times 10^{-19}\ C$
Faraday's Constant	$\mathcal{F} = 9.65 \times 10^{4}\ C/mol$
Index of Refraction of Air	$n = 1.00$
Speed of Light in Vacuum	$c = 3.00 \times 10^{8}\ m/s$

ATOMIC PHYSICS

Energy of an Electron in the 1st Bohr Orbit of Hydrogen	$E_1 = -2.18 \times 10^{-18}\ J$ or $-13.6\ eV$
Planck's Constant	$h = 6.63 \times 10^{-34}\ J \cdot s$
Radius of 1st Bohr Orbit of Hydrogen	$r_1 = 5.29 \times 10^{-11}\ m$
Rydberg's Constant	$R_H = 1.10 \times 10^{7}/m$

PARTICLES

	Rest Mass	Charge
Alpha Particle	$m_\alpha = 6.65 \times 10^{-27}$ kg	α^{2+}
Electron	$m_e = 9.11 \times 10^{-31}$ kg	e^-
Neutron	$m_n = 1.67 \times 10^{-27}$ kg	n^0
Proton	$m_p = 1.67 \times 10^{-27}$ kg	p^+

TRIGONOMETRY

$$\sin\Theta = \frac{\text{opposite}}{\text{hypotenuse}} \qquad \cos\Theta = \frac{\text{adjacent}}{\text{hypotenuse}} \qquad \tan\Theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \qquad c^2 = a^2 + b^2 - 2ab\cos C$$

VALUES OF TRIGONOMETRIC FUNCTIONS

Angle	Sin	Cos	Tan	Angle	Sin	Cos	Tan
1°	0.0175	0.9998	0.0175	46°	0.7193	0.6947	1.0355
2°	0.0349	0.9994	0.0349	47°	0.7314	0.6820	1.0724
3°	0.0523	0.9986	0.0524	48°	0.7431	0.6691	1.1106
4°	0.0698	0.9976	0.0699	49°	0.7547	0.6561	1.1504
5°	0.0872	0.9962	0.0875	50°	0.7660	0.6428	1.1918
6°	0.1045	0.9945	0.1051	51°	0.7771	0.6293	1.2349
7°	0.1219	0.9925	0.1228	52°	0.7880	0.6157	1.2799
8°	0.1392	0.9903	0.1405	53°	0.7986	0.6018	1.3270
9°	0.1564	0.9877	0.1584	54°	0.8090	0.5878	1.3764
10°	0.1736	0.9848	0.1763	55°	0.8192	0.5736	1.4281
11°	0.1908	0.9816	0.1944	56°	0.8290	0.5592	1.4826
12°	0.2079	0.9781	0.2126	57°	0.8387	0.5446	1.5399
13°	0.2250	0.9744	0.2309	58°	0.8480	0.5299	1.6003
14°	0.2419	0.9703	0.2493	59°	0.8572	0.5150	1.6643
15°	0.2588	0.9659	0.2679	60°	0.8660	0.5000	1.7321
16°	0.2756	0.9613	0.2867	61°	0.8746	0.4848	1.8040
17°	0.2924	0.9563	0.3057	62°	0.8829	0.4695	1.8807
18°	0.3090	0.9511	0.3249	63°	0.8910	0.4540	1.9626
19°	0.3256	0.9455	0.3443	64°	0.8988	0.4384	2.0503
20°	0.3420	0.9397	0.3640	65°	0.9063	0.4226	2.1445
21°	0.3584	0.9336	0.3839	66°	0.9135	0.4067	2.2460
22°	0.3746	0.9272	0.4040	67°	0.9205	0.3907	2.3559
23°	0.3907	0.9205	0.4245	68°	0.9272	0.3746	2.4751
24°	0.4067	0.9135	0.4452	69°	0.9336	0.3584	2.6051
25°	0.4226	0.9063	0.4663	70°	0.9397	0.3420	2.7475
26°	0.4384	0.8988	0.4877	71°	0.9455	0.3256	2.9042
27°	0.4540	0.8910	0.5095	72°	0.9511	0.3090	3.0777
28°	0.4695	0.8829	0.5317	73°	0.9563	0.2924	3.2709
29°	0.4848	0.8746	0.5543	74°	0.9613	0.2756	3.4874
30°	0.5000	0.8660	0.5774	75°	0.9659	0.2588	3.7321
31°	0.5150	0.8572	0.6009	76°	0.9703	0.2419	4.0108
32°	0.5299	0.8480	0.6249	77°	0.9744	0.2250	4.3315
33°	0.5446	0.8387	0.6494	78°	0.9781	0.2079	4.7046
34°	0.5592	0.8290	0.6745	79°	0.9816	0.1908	5.1446
35°	0.5736	0.8192	0.7002	80°	0.9848	0.1736	5.6713
36°	0.5878	0.8090	0.7265	81°	0.9877	0.1564	6.3138
37°	0.6018	0.7986	0.7536	82°	0.9903	0.1392	7.1154
38°	0.6157	0.7880	0.7813	83°	0.9925	0.1219	8.1443
39°	0.6293	0.7771	0.8098	84°	0.9945	0.1045	9.5144
40°	0.6428	0.7660	0.8391	85°	0.9962	0.0872	11.4301
41°	0.6561	0.7547	0.8693	86°	0.9976	0.0698	14.3007
42°	0.6691	0.7431	0.9004	87°	0.9986	0.0523	19.0811
43°	0.6820	0.7314	0.9325	88°	0.9994	0.0349	28.6363
44°	0.6947	0.7193	0.9657	89°	0.9998	0.0175	57.2900
45°	0.7071	0.7071	1.0000	90°	1.0000	0.0000	

EQUATIONS

Kinematics

$$\vec{v}_{ave} = \frac{\vec{d}}{t} \qquad \vec{d} = \left(\frac{\vec{v}_f + \vec{v}_i}{2} \right) t$$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t} \qquad v_f^2 = v_i^2 + 2ad$$

$$\vec{d} = \vec{v}_i t + {}^1/_2 \vec{a} t^2$$

Dynamics

$$\vec{F} = m\vec{a} \qquad g = \frac{Gm_1}{R^2}$$

$$\vec{F}t = m\Delta\vec{v} \qquad F_c = \frac{mv^2}{R}$$

$$\vec{F}_g = m\vec{g} \qquad F_c = \frac{4\pi^2 mR}{T^2}$$

$$F_g = \frac{Gm_1 m_2}{R^2}$$

Momentum & Energy

$$\vec{p} = m\vec{v} \qquad P = \frac{W}{t}$$

$$W = Fd \qquad E_k = {}^1/_2 mv^2$$

$$W = Fd \cos \Theta \qquad E_p = mgh$$

Waves & Light

$$v = f\lambda \qquad \lambda = \frac{xd}{nl}$$

$$T = \frac{1}{f} \qquad \lambda = \frac{d \sin \Theta}{n}$$

$$\frac{\sin \Theta_1}{\sin \Theta_2} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$$

EQUATIONS

Electricity & Magnetism

$$F_e = \frac{kq_1q_2}{R^2}$$

$$|\vec{E}| = \frac{kq_1}{R^2}$$

$$|\vec{E}| = \frac{F_e}{q}$$

$$|\vec{E}| = \frac{V}{d}$$

$$V = \frac{\Delta E}{q}$$

$$V = IR$$

$$P = IV = I^2R = \frac{V^2}{R}$$

$$I = \frac{q}{t}$$

$$F_m = IlB_\perp$$

$$F_m = qvB_\perp$$

Atomic Physics

$$m = \frac{It}{9.65 \times 10^4 \text{ C/mol}} \cdot \frac{A}{v}$$

$$E_{k_{max}} = hf - W$$

$$W = hf_0$$

$$E_{k_{max}} = qV_{stop}$$

$$E = hf = \frac{hc}{\lambda}$$

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

$$E_n = \frac{1}{n^2}E_1$$

$$r_n = n^2r_1$$

Relativity & Quantum Physics

$$E = mc^2$$

$$E_k = (m - m_0)c^2$$

$$m = \frac{m_0}{\sqrt{1 - v^2/c^2}}$$

$$p = \frac{h}{\lambda} = \frac{hf}{c}$$

$$\Delta x \Delta p \geq \frac{h}{4\pi}$$

$$2\pi r_n = n\lambda$$

PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA or 0
3 Li 1.0 lithium 6.94	4 Be 1.5 beryllium 9.01									5 B 2.0 boron 10.81	6 C 2.5 carbon 12.01				
11 Na 0.9 sodium 22.99	12 Mg 1.2 magnesium 24.31									13 Al 1.5 aluminum 26.98	14 Si 1.8 silicon 28.09	15 P 2.1 phosphorous 30.97	16 S 2.5 sulphur 32.06		
19 K 0.8 potassium 39.10	20 Ca 1.0 calcium 40.08	21 Sc 1.3 scandium 44.96	22 Ti 1.5 titanium 47.90	23 V 1.6 vanadium 50.94	24 Cr 1.6 chromium 52.00	25 Mn 1.5 manganese 54.94	26 Fe 1.8 iron 55.85	27 Co 1.8 cobalt 58.93	28 Ni 1.8 nickel 58.71	29 Cu 1.9 copper 63.55	30 Zn 1.6 zinc 65.38	31 Ga 1.6 gallium 69.74	32 Ge 1.8 germanium 72.59	33 As 2.0 arsenic 74.92	34 Se 2.4 selenium 78.96		
37 Rb 0.8 rubidium 85.47	38 Sr 1.0 strontium 87.62	39 Y 1.3 yttrium 88.91	40 Zr 1.4 zirconium 91.22	41 Nb 1.6 niobium 92.91	42 Mo 1.8 molybdenum 95.94	43 Tc 1.9 technetium 98.91	44 Ru 2.2 ruthenium 101.07	45 Rh 2.2 rhodium 102.91	46 Pd 2.2 palladium 106.40	47 Ag 1.9 silver 107.87	48 Cd 1.7 cadmium 112.41	49 In 1.7 indium 114.82	50 Sn 1.8 tin 118.69	51 Sb 1.9 antimony 121.75	52 Te 2.1 tellurium 127.60	53 I 2.5 iodine 126.90	
55 Cs 0.7 cesium 132.91	56 Ba 0.9 barium 137.33	57-71	72 Hf 1.3 hafnium 178.49	73 Ta 1.5 tantalum 180.95	74 W 1.7 tungsten 183.85	75 Re 1.9 rhenium 186.21	76 Os 2.2 osmium 190.20	77 Ir 2.2 iridium 192.22	78 Pt 2.2 platinum 195.09	79 Au 2.4 gold 196.97	Hg	81 Tl 1.8 thallium 204.37	82 Pb 1.8 lead 207.19	83 Bi 1.9 bismuth 208.98	84 Po 2.0 polonium (209)	85 At 2.2 astatine (210)	
87 Fr 0.7 francium (223)	88 Ra 0.9 radium 226.03	89-103	104 Rf — rutherfordium (260)	105 Ha — hahnium (260)	106 — (263)	107 —											

KEY

ATOMIC NUMBER → 1 H ← SYMBOL OF THE ELEMENT
2.1 ← ELECTRONEGATIVITY
NAME OF THE ELEMENT → hydrogen 1.01 ← ATOMIC MASS

BASED ON $^{12}_{6}C$

( ) INDICATES MASS OF THE MOST STABLE ISOTOPE

NOTE: The Legend at right denotes the physical state of the elements at 101 kPa and 298 K (25°C)

LEGEND

SOLID

LIQUID

GAS

57 La 1.1 lanthanum 138.91	58 Ce 1.1 cerium 140.12	59 Pr 1.1 praseodymium 140.91	60 Nd 1.2 neodymium 144.24	61 Pm — promethium (145)	62 Sm 1.2 samarium 150.35	63 Eu — europium 151.96	64 Gd 1.1 gadolinium 157.25	65 Tb 1.2 terbium 158.93	66 Dy — dysprosium 162.50	67 Ho 1.2 holmium 164.93	68 Er 1.2 erbium 167.26	69 Tm 1.2 thulium 168.93	70 Yb 1.1 ytterbium 173.04	71 Lu 1.2 lutetium 174.97
89 Ac 1.1 actinium (227)	90 Th 1.3 thorium 232.04	91 Pa 1.5 protactinium 231.04	92 U 1.7 uranium 238.03	93 Np 1.3 neptunium 237.05	94 Pu 1.3 plutonium (244)	95 Am 1.3 americium (243)	96 Cm — curium (247)	97 Bk — berkelium (247)	98 Cf — californium (251)	99 Es — einsteinium (254)	100 Fm — fermium (257)	101 Md — mendelevium (258)	102 No — nobelium (259)	103 Lr — lawrencium (260)